

CLAIMS

What is claimed is:

5 1. A particle-based electrochemical power source comprising one or more cells, each of which comprises:

 a particulate anode comprising a static or quasi-static flow of electroactive particles;

 a cathode;

10 a flow of reaction solution through the particulate anode along a flow path or a means for delivering the flow of reaction solution; and

 one or more particle releasers situated along the flow path and configured to allow at least a portion of the electroactive particles to exit the cell in the flow of reaction solution and/or to maintain the porosity of and the flow of reaction solution
15 through the anode sufficiently to allow for efficient operation of the cell.

 2. The power source of claim 1 wherein the particle releasers are configured to allow electroactive particles to exit the cell in the flow of reaction solution and to maintain the porosity of and the flow of reaction solution through the anode sufficiently to allow for efficient operation of the cell.

20 3. The power source of claim 1 wherein the particle releasers are further configured to release sufficient electroactive particles to prevent the substantially nonuniform accumulation of reaction products within the cell cavity.

 4. The power source of claim 1 wherein the particle releasers are further configured to release sufficient electroactive particles to maintain the flow of
25 electroactive particles such that recirculation of at least a portion of such electroactive particles occurs.

 5. The power source of claim 1 wherein the electroactive particles comprise zinc particles.

30 6. The power source of claim 5 wherein the reaction solution comprises potassium hydroxide.

7. A metal-based fuel cell comprising the power source of claim 1.
8. The power source of claim 1 wherein the cells are combined in series.
9. The power source of claim 1 wherein the cells are combined in parallel.

5 10. The power source of claim 1 wherein the means for delivering also delivers electroactive particles to the anode in the recirculating flow of reaction solution.

11. The power source of claim 1 wherein the one or more particle releasers are configured to maintain the porosity ϵ of the particulate anode in the range from
10 about 0.4 to about 0.8.

12. The power source of claim 1 wherein the one or more particle releasers are configured to maintain the porosity ϵ of the particulate anode greater than about 0.4.

13. The power source of claim 1 wherein the one or more particle releasers
15 are configured to maintain the porosity ϵ of the particulate anode greater than about 0.2.

14. The power source of claim 1 wherein the one or more particle releasers are configured to maintain the porosity ϵ of the particulate anode greater than about 0.

15. The power source of claim 1 wherein the flow of reaction solution is
20 delivered through the anode during anodic dissolution.

16. The power source of claim 15 wherein the flow of reaction solution is a re-circulating flow of reaction solution.

17. The power source of claim 1 wherein at least a portion of the electroactive particles are recirculated.

25 18. A method of operating an individual cell within a particle-based electrochemical power source, the individual cell comprising a cathode and a particulate anode comprising electroactive particles, the method comprising:

delivering a flow of reaction solution through the particulate anode;

allowing the anode to undergo anodic dissolution, thereby reducing the size of
30 the electroactive particles; and

allowing at least a portion of the electroactive particles to exit the cell.

19. The method of claim 18 wherein the electroactive particles comprises zinc particles.

20. The method of claim 19 wherein the reaction solution comprises
5 potassium hydroxide.

21. The method of claim 18 further comprising allowing electroactive particles that are likely to cause clogging to exit the cell in the flow of reaction solution.

22. The method of claim 18 further comprising maintaining sufficient
10 porosity of and flow through the particulate anode to enable efficient operation of the cell.

23. The method of claim 22 wherein the porosity ϵ of the particulate anode is in the range from about 0.4 to about 0.8.

24. The method of claim 22 wherein the porosity ϵ of the particulate anode
15 is greater than about 0.4.

25. The method of claim 22 wherein the porosity ϵ of the particulate anode is greater than about 0.2.

26. The method of claim 22 wherein the porosity ϵ of the particulate anode is greater than about 0.

27. The method of claim 11 further comprising delivering electroactive
20 particles to the anode in the flow of reaction solution.

28. The method of claim 11 wherein the flow of reaction solution is a recirculating flow of reaction solution.

29. The method of claim 22 wherein at least a portion of the electroactive
25 particles are recirculated.

30. A power source, the power source having one or more cells, each of which comprises:

a particulate anode comprising a static or quasi-static flow of electroactive particles confined by a planar cavity;

30 a planar cathode;

a recirculating flow of reaction solution through the particulate anode along a flow path or a means for delivering the flow of reaction solution; and

one or more particle releasers situated along the flow path and configured to allow at least a portion of the electroactive particles to exit the cell in the recirculating
5 flow of the reaction solution and/or to maintain the porosity of and the flow of reaction solution through the anode sufficiently to allow for efficient operation of the cell.

31. The power source of claim 30 wherein the thickness of the planar cavity confining the particulate anode is between about two and about three times the
10 original diameter of the electroactive particles.

32. The cell of claim 30 wherein the porosity of the particulate anode is maintained in the range of about 0.4 to about 0.8.

33. The cell of claim 32 wherein the flow rate of reaction solution through the particulate anode is maintained at a superficial velocity in the range of about 10 to
15 about 200 cm/min.

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